Lesser Prairie-Chicken
Tympanuchus pallidicinctus
Order
GALLIFORMES
– Family
PHASIANIDAE
Issue No. 364 – Revised: October 1, 2005
Authors: Giesen, Kenneth M.
Revisors: Hagen, Christian A.

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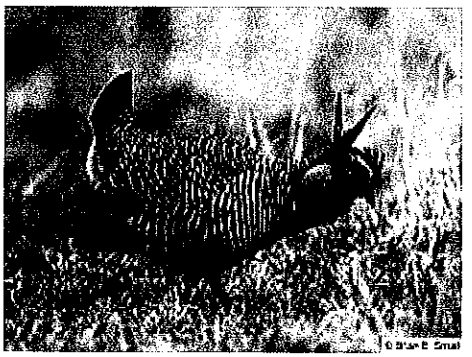
Introduction



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Adult male

Lesser Prairie-Chicken, Gobbling Display; Kansas, May

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Adult female

Lesser Prairie-Chicken; Colorado, April

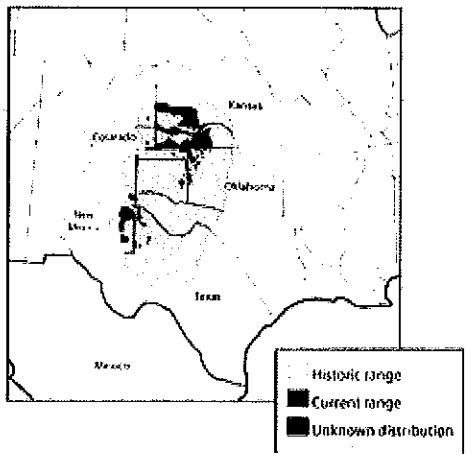

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Fig. 1.
Distribution of the Lesser Prairie-Chicken, past and present.

The Lesser Prairie-Chicken has one of the smallest population sizes and most restricted distributions of North American grouse, second only to Gunnison Sage-Grouse (*Centrocercus minimus*). Historically a popular game species in several states, it has not been studied as intensively as have other more common and widely distributed North American gallinaceous game birds. Much of what is known about the nesting biology and seasonal habitat preferences of this species has been learned through a series of short-term graduate research projects undertaken in the last 30 years. Conservation concern for this species initiated a number of intensive studies from universities and state agencies in recent years. Specific information on energetics, nutritional needs, and population and meta-population responses to habitat changes, including fragmentation, are not well understood. Declining populations and spectacular breeding displays have attracted the attention of biologists and bird-watchers to this species in recent years.

The Lesser Prairie-Chicken inhabits rangelands dominated primarily by shinnery oak (*Quercus havardii*) or sand sagebrush (*Artemisia filifolia*) in 5 states within the southern Great Plains. Its distribution and population size have been reduced by the activities of humans, even though it occurs in areas with low human population densities. Recurrent droughts, combined with excessive grazing of rangelands by livestock and conversion of native rangelands to cropland, have significantly reduced populations and the distribution of the Lesser Prairie-Chicken since the early 1900s. This species is located and observed most easily in spring when males gather on traditional arenas (commonly called leks or gobbling grounds) to display and mate with females. Although generally comparable in morphology, plumage, and behavior to the partially sympatric Greater Prairie-Chicken (*Tympanuchus cupido*), the Lesser Prairie-Chicken is smaller, its courtship displays and vocalizations are distinctive, and it typically occupies midgrass rangelands associated with sandy soils rather than native tallgrass prairies interspersed with agricultural habitats.

Distinguishing Characteristics

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Distinguishing Characteristics

Enlarge

Adult male

Lesser Prairie-Chicken; Colorado, April

Enlarge

Adult female

Lesser Prairie-Chicken; Colorado, April

Medium-sized, grayish brown grouse. Total length 38–41 cm (Johnsgard 1983, Olawsky 1987). Sexes similar, and plumages similar throughout year. In adults, most of body is barred with alternating dark (brown) and light (buffy white) bands. Dark bands on upperparts are complex, including black and cinnamon tones; light bands on upperparts range from buff to white. Upperparts are therefore darker and more richly colored than underparts. Chin and throat largely unmarked. Tail short, rounded, and brownish black. Male displays bright yellow eye-comb above eye and dull red esophageal "air sacs" on side of neck during

courtship (Copelin 1963, Sutton 1977, Johnsgard 1983). Male also has a tuft of elongated feathers (pinnae) on each side of neck; these are held erect during courtship display. Females have shorter pinnae. Immatures similar to adults, but more richly colored, especially on throat.

Lesser Prairie-Chicken almost identical in appearance to and difficult to distinguish from Greater Prairie-Chicken. Latter species is slightly larger, with orange cervical air sacs in males, and slightly darker plumage coloration overall. Although attempts have been made to distinguish the species by the number of dark bars on the back-feathers (1 in Greater versus 3 in Lesser; Copelin 1963), the 2 species show more similarities than differences in these feathers. Breast feathers with 4–6 alternating brown and white bars in Lesser Prairie-Chicken compared to 1–4 alternating brown and white bars in Greater Prairie-Chicken (Short 1967). Downy young of Lesser Prairie-Chicken are also similar to those of Greater (Short 1967), although slightly paler, with less brownish underparts (Sutton 1968).

Lesser Prairie-Chicken also similar to Sharp-tailed Grouse (*T. phasianellus*), but latter species lacks elongated neck pinnae, has pointed (not rounded) tail with white outer rectrices, and underparts are paler and marked with V-shaped markings instead of bars. Male Sharp-tailed Grouse also has purple air sac.

Overall, Lesser Prairie-Chicken is most easily distinguished by its geographic range, which does not overlap the range of Sharp-tailed Grouse and does only in a few counties of Greater Prairie-Chicken range in Kansas.

Distribution Introduction

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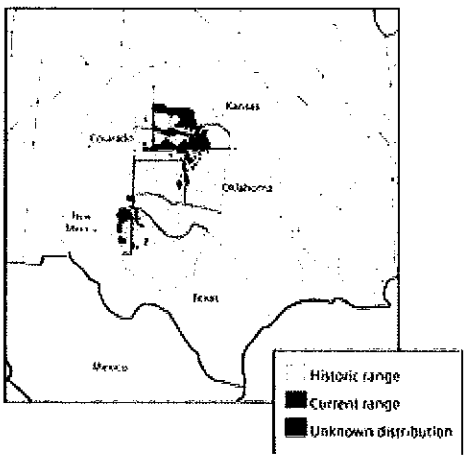

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Fig. 1. Distribution of the Lesser Prairie-Chicken, past and present.

The Americas

Breeding Range

Figure 1 . Restricted to: Baca, Prowers, and Kiowa counties in extreme se. Colorado (Hoffman 1963, Giesen 1994a, Giesen 2000); sw. Kansas counties bordering Colorado and Oklahoma, primarily south of Interstate Highway 70 and west of Great Bend (Thompson and Ely 1989, Jensen et al. 2000); the panhandle and nw. counties of Oklahoma (Sutton 1967, Cannon and Knopf 1981, Wood and Schnell 1984, Baumgartner and Baumgartner 1992, Horton 2000); se. New Mexico from Harding and Union counties on the north to Eddy and Lea counties on the south, with the core of the remaining distribution in e. Chaves, s. Roosevelt, and n. Lea counties (Bailey 1928, Ligon 1961, Hubbard 1978, Bailey and Williams 2000); and the northeastern and southwestern counties along the Oklahoma and New Mexico borders, respectively, of the Texas panhandle (Oberholser 1974, Sullivan et al. 2000).

Winter Range

At present, same as breeding range. Historically, may have been migratory (Sharpe 1968), breeding in northern part of its range and wintering farther south (Bent 1932). Litton (1978) reported estimates of 2 million Lesser Prairie-Chickens in Texas before 1900; this area may have represented the core of the species' wintering grounds, although Taylor and Guthery (1980c) argued that these were resident birds inhabiting vegetative communities similar to those used by breeding populations elsewhere. Historical records of wintering birds in sw. Missouri (Johnsgard 1983) have been questioned because the records are substantially east of the known range of this species (Robbins and Easterla 1992).

Outside The Americas

Species reportedly released on Ni'ihau I., HI (Fisher 1951), but no population is known to exist there now. Not recorded elsewhere outside the Americas.

Historical Changes

Historical distribution uncertain because of its similarity to and possible confusion with that of Greater Prairie-Chicken; Lesser Prairie-Chicken first recognized as distinct species in 1885 (Ridgway 1885). May have inhabited extreme sw. Nebraska or expanded its range into this area after settlement by European Americans (Bent 1932, Am. Ornithol. Union 1983). Fall and winter observations and collections from sandhills of n.-central Nebraska as late as 1920s, but no documentation of breeding there (Sharpe 1968). Currently found in all 5 states within its documented historical range (Aldrich and Duvall 1955, Aldrich 1963, Sands 1968, Crawford 1980), although populations have become fragmented and isolated in most states (Fig. 1). Documented distribution declined 78% between 1963 and 1980 and 92% since 1800s (Taylor and Guthery 1980c).

Fossil History

Fossil remains described from Oregon (Ridgway and Friedmann 1946) and Rocky Arroyo (near Carlsbad), NM (Wetmore 1932, Howard and Miller 1933). Hubbard (1973) postulated its presence in Chihuahuan Refugium during Pleistocene glaciation. An extinct species of prairie-chicken (*T. ceres*), similar to but slightly smaller than Lesser Prairie-Chicken, was described from Newton Co., AR (Shufeldt 1913), and another species, *T. stirtoni*, was found in Bennett Co., SD (Miller 1944).

Systematics Distinguishing Characteristics

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Systematics

Geographic Variation

None reported (see Appearance).

Subspecies

No recognized subspecies.

Related Species

Ridgway (1873) first described this bird as a race of Greater Prairie-Chicken, but it was given specific status in 1885 (Ridgway 1885). Aldrich and Duvall (1955) considered Greater and Lesser prairie-chickens conspecific, varying morphologically only in degree. Aldrich (1963) and Jones (1964a) presented behavioral and morphological data indicating specific distinctness between the 2 species. Short (1967) and Johnsgard and Wood (1968) suggested that Lesser Prairie-Chicken be considered a subspecies of Greater Prairie-Chicken and distinct from Sharp-Tailed Grouse. Sharpe (1968) argued that the 2 prairie-chickens should be considered allospecies because of their historical and current distributions. Hjorth (1970) concluded that the 2 were separate species after detailed studies of their breeding behavior. Although Crawford (1978) reported fertile offspring from mating of Greater and Lesser prairie-chickens in captivity, he considered them separate species. Recent genetic studies (Ellsworth et al. 1994, 1995) have indicated a low level of interspecific divergence and polyphyletic distribution of haplotypes from North American prairie grouse. This finding indicates recent speciation, with morphological and behavioral differences between Greater and Lesser prairie-chickens most likely resulting from sexual selection or adaptation to different environmental conditions.

One record of hybridization between Lesser and Greater prairie-chickens, involving captive birds (Johnsgard 1973, Crawford 1978). Resultant offspring were fertile and displayed a

blending of morphological and behavioral characteristics of both species (Crawford 1978). Populations of Lesser and Greater prairie-chickens have recently been documented hybridizing in the northern extent of Lesser range in Kansas (Bain and Farley 2002, Fields 2004). The hybridization rate in the zone of sympatry is currently unknown. A genetic analysis of these populations is forthcoming (CAH).

Migration Distribution

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Migration

Most populations are considered nonmigratory; seasonal movements and home ranges typically are restricted to suitable habitats adjacent to leks (see Distribution, above). Historically, populations were thought to be migratory, although no evidence for migration was provided (Bent 1932). Taylor and Guthery (1980c) suspected that birds observed in southern parts of their range in winter were residents rather than migrants; they reported that movements of birds may have been local population responses to extreme food shortages, severe weather, or other phenomena.

Taylor and Guthery (1980a) reported a movement of 12.8 km by 1 radiomarked bird in Texas, but suggested it represented dispersal of juveniles rather than true migration. In New Mexico, Campbell (1972) reported maximum movements between spring leks and late-fall locations of 20.8 and 3.2 km for subadult (n = 9) and adult birds (n = 4), respectively. In Oklahoma, Copelin (1963) reported that most movements between fall or winter sites and spring leks were <2.4 km (maximum 8, n = 114 birds). These movements may have resulted from dispersal of juveniles or movements of local populations to agricultural crops used as food resources in winter rather than true migration. 7% of 348 movements by individuals of this species in sw. Kansas exceeded 30 km; a few of those birds returned to areas of capture the following year (Hagen 2003).

Habitat Systematics

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Habitat

Breeding Range

Sand sagebrush–bluestem (*Andropogon* spp.) and shinnery oak–bluestem vegetation types (Kuchler 1964) coincide with original distribution of Lesser Prairie-Chicken (Sharpe 1968). Currently most common in dwarf shrub–mixed grass vegetation associated with sandy soils, sometimes interspersed with short-grass or mixed-grass habitats on loamy or clayey soils (Taylor and Guthery 1980c). In Colorado and Kansas, typically restricted to sand sagebrush communities dominated by sand dropseed (*Sporobolus cryptandrus*), side oats grama (*Bouteloua curtipendula*), three-awn (*Aristida* spp.), and blue grama (*B. gracilis*; Baker 1953, Hoffman 1963, Horak 1985, Giesen 1991, 1994a, 1994b).

Recently, increased usage of mixed-grass prairie and Conservation Reserve Program (CRP) fields has been documented in the northern fringe of the range (Kansas; Fields 2004). Most CRP fields used by nesting and brood rearing females had been interseeded with various forb mixtures. In Oklahoma, Texas, and New Mexico, prefers shinnery oak–bluestem habitats dominated with sand bluestem (*Bouteloua hallii*), little bluestem (*B. scoparium*), sand dropseed, three-awn, and blue grama in addition to sand sagebrush communities (Copelin 1963, Jackson and DeArment 1963, Jones 1963a, 1963b, Litton 1978, Davis et al. 1979, Riley et al. 1993b). In Oklahoma, higher densities observed in shinnery oak habitats than in sand sagebrush habitats (Copelin 1963, Donaldson 1969, Cannon 1980). In Texas, shinnery oak rangeland with 5–37% small-grain cropland had higher populations than 100% native rangeland had (Crawford and Bolen 1976a). However, areas with <63% native rangeland appeared incapable of sustaining populations.

Display grounds used for breeding (leks) are characterized by sparse vegetation and are typically located on knolls or ridges (Jones 1963b, Copelin 1963, Cannon and Knopf 1979, Taylor and Guthery 1980c, Giesen 1991). Selection for sparse vegeta-tive cover may be more important than elevation (Hjorth 1970). Human-created disturbances, including roads,

oil pads, and herbicide treatments, may serve as focal areas for lek establishment (Crawford and Bolen 1976a, Davis et al. 1979, Sell 1979, Taylor 1979, Ahlborn 1980, Locke 1992). Traditional leks may change location in response to disturbances, including agricultural tillage or fires (Crawford and Bolen 1976c, Cannon and Knopf 1979).

Habitats used for nesting and brood-rearing are usually within 3 km of display grounds (Giesen 1994b; see Breeding: nest site, below). Taller trees and shrubs, including shinnery oak mottes, sand sagebrush, fragrant sumac (*Rhus aromatica*), and sand chickasaw plum (*Prunus angustifolia watsoni*) are used for shade in summer (Copelin 1963).

Spring And Fall Migration

Not currently known to migrate.

Winter Range

Winter ranges similar to breeding habitats; makes greater use of small-grain agricultural fields where available than during breeding or summer season (Jamison 2000, Salter et al. 2005). Riparian zones adjacent to native rangelands with adequate willow (Salix spp.) and other deciduous cover can also provide suitable winter range (Schwilling 1955).

Food Habits Migration

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Food Habits

Feeding

Main Foods Taken

Insects, seeds, leaves, buds, and cultivated grains dominate annual diet throughout range (Copelin 1963, Jones 1963a, 1964b, Donaldson 1969, Crawford 1974, Crawford and Bolen 1976b, Davis et al. 1979, Olawsky 1987, Riley et al. 1993a).

Microhabitat For Foraging

Typically on the ground in native rangeland or in grain fields (KMG).

Food Capture And Consumption

Few data. Adults forage alone or in small flocks mostly in early morning or late afternoon; broods feed throughout day (KMG). Stores food in crop for later digestion. Uses muscular gizzard and grit to grind food items.

Diet

Juveniles

Diet of juveniles <10 wk old in New Mexico consists primarily of insects, especially short-horned grasshoppers (Acrididae), long-horned grasshoppers (Tettigoniidae), and beetles (Coleoptera; Davis et al. 1979). Diet of 2 juveniles <2 wk old consisted primarily of treehoppers (Membracidae; Davis et al. 1979). In Oklahoma, principal food of juveniles was insects; >85% of content of collected brood dropping consisting of insects (Jones 1963a; 1964b). Brood habitats were comprised of significantly greater invertebrate biomass and forb cover than areas not frequented by broods in Kansas (Hagen et al. 2005b).

Adults

Spring and Summer. Diet of New Mexico adults in summer was approximately 55% animal matter (primarily long-horned grasshoppers, short-horned grasshoppers, and treehoppers),

23% vegetative material (primarily leaves and flowers), and 22% mast and seeds (primarily shinnery oak acorns; *n* = 18 birds; Davis et al. 1979). Summer habitats had greater invertebrate biomass and forb cover than areas not used by adult Lesser Prairie-Chickens (Jamison et al. 2002).

Fall and Winter. In New Mexico, diet is mixture of seeds (43%), vegetative material (39%), and insects (15%) in autumn (*n* = 26 birds), and primarily shinnery oak acorns (69%) and wild buckwheat (*Eriogonum annuum*; 14%) in winter (*n* = 6 birds; Riley et al. 1993a). Shinnery oak acorns, leaves, catkins, leaves, and insect galls provided >50% of fall and winter diet (Riley et al. 1993a). No information on diet from sand sagebrush habitats.

Food Selection And Storage

No information.

Nutrition And Energetics

Few data on nutritional needs or energetic requirements. Body fat of both sexes typically <5% (Olawsky 1987), indicating that energy is derived from daily foraging activities rather than from lipid reserves.

Metabolism And Temperature Regulation

No information.

Drinking, Pellet-Casting, And Defecation

Uses free water, typically from stock ponds, when available in spring (Crawford and Bolen 1973, Sell 1979), summer and fall (Copelin 1963, Jones 1964a, Sell 1979), and winter (Taylor 1978). Obtains necessary moisture usually through food, since original distribution of Lesser Prairie-Chicken was not limited to rangeland having free water.

Produces both intestinal and cecal droppings daily. Intestinal droppings are cylindrical and tend to be soft and moist during summer and hard and dry in winter. Cecal droppings tend to be deposited once or twice daily, and are often observed at lek sites in spring and fall or at roost sites throughout year (KMG).

Sounds Habitat

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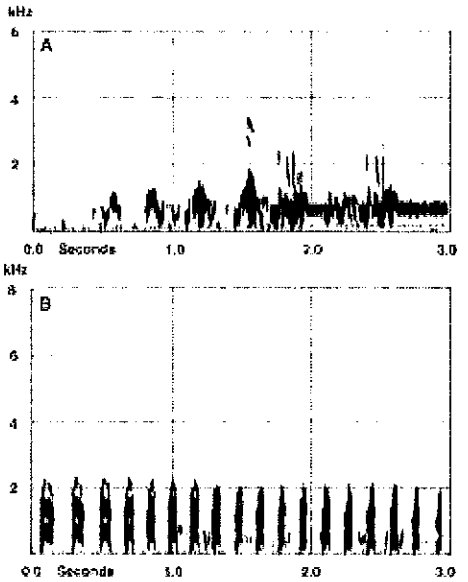

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Fig. 2. Calls of Lesser Prairie-Chicken.

Vocalizations

Development

No information.

Vocal Array

Male. Predominant male vocalization on breeding grounds when assembling at leks is a high-intensity Booming call, often described as gobbling (Copelin 1963, Haukos 1988), bubbling (Grange 1940), or yodeling (Hjorth 1970; Fig. 2A). Other vocalizations on leks include Cackling, described as *ko-aaa-ka-ka-ka-ka* or *quat, quat, quat, quat, quat, quat* (Grange 1940, Sharpe 1968, Hjorth 1970; Fig. 2B), Whining (high pitched whine), Quarreling (a nasal call with many of the elements of whining), Pike Call (Sharpe 1968), and Soft

Squeak (a voiced panting, given with bill open; Hjorth 1970). Often Cackle when flushed (KMG).

Female. Booming on leks (Sharpe 1968), sometimes described as *clock-clock-clock* (Haukos 1988). Cackles when flushed (KMG).

Phenology
Vocalizations greatest during breeding season (Mar–Jun) on leks (KMG).

Daily Pattern
Vocalizations most frequent during dawn and dusk activities on leks (KMG).

Repertoire And Delivery Of Songs
High-intensity Gobbling in males lasts approximately 0.6 s and has 3 "syllables" or phrases, with frequency of 500–1,000 Hz (Sharpe 1968). Low-intensity Gobbling sounds are more like a 4-syllable gobble lasting 0.36 s (Sharpe 1968). Antiphonal Booming, or Dueting, occurs between 2 adjacent males, is of high intensity, begins slowly, and increases in rate (Sharpe 1968, Hjorth 1970). As many as 10 Booming calls may be heard in rapid succession during session of Antiphonal Booming, which typically lasts 3–4 s. During Flutter Jump (see Behavior: agonistic behavior, below), 80% of males Cackled. Pike, or Squeak, Call is short (0.23 s), and greatest sound amplitude occurs at about 1,000 Hz.

Social Context And Presumed Functions
Male. Gives Gobbling vocalizations during lekking displays in spring (see Behavior, below) and may serve to advertise location of lek to hens, to defend male's individual territory within the lek, and to help hens ascertain quality of males (Sharpe 1968). Flutter Jump Cackle given during Flutter Jump is especially common among peripheral males when hens are near center of display ground and may be elicited by females flying onto display ground (Sharpe 1968, Hjorth 1970, Haukos 1988).

Female. Gobbling given by presumed dominant female when several hens on lek (Haukos 1988).

Nonvocal Sounds

During Gobbling Display (see Behavior: agonistic behavior, below), males produce sounds by stamping feet, shaking wings, fluttering wings, and flicking tail. During foot-stamping, feet hit ground 16–17 times/s, but forward movement seldom exceeds 0.5 m; often the males seem to be marching in place (Sharpe 1968, Hjorth 1970). Commonly only 1 or 2 double stamps are observed. Males shake wings at beginning of Gobbling Display as they droop their wings and spread their primaries (Sharpe 1968). During Flutter Jump (see Behavior: agonistic behavior, below), wing-beats can be heard up to distance of 30 m (Hjorth 1970). During intense Gobbling Display, as male ceases stamping, he fans tail and produces a rustling sound by flicking his rectrices (Grange 1940, Sharpe 1968, Hjorth 1970).

Behavior Food Habits
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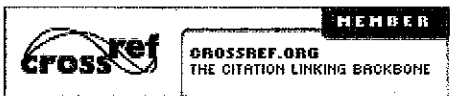

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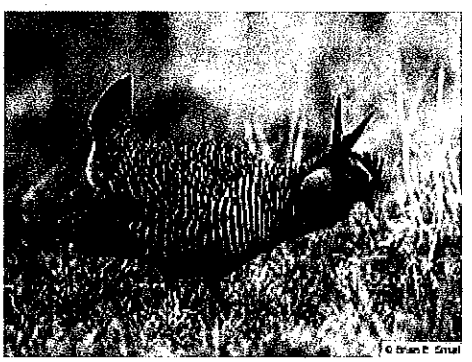
About the Author(s)

Behavior



Enlarge

Adult male

Lesser Prairie-Chicken, Gobbling Display; Kansas, May

Locomotion

Walking, Hopping, Climbing, Etc

Largely terrestrial while feeding, loafing, brood-rearing, and roosting.

Flight

Typically flies when disturbed, when moving to and from gobbling grounds (leks), and during nest recesses (KMG). Frequently flies when moving between feeding areas and loafing or roosting sites, or when flying to water sources near leks. Most flights <1 km, although able to fly farther (KMG). Flight generally below 100 m, characterized by alternate wing-flapping and gliding.

Swimming And Diving

Not known to swim or dive.

Self-Maintenance

Preening, Head-Scratching, Stretching, Bathing, Anting, Etc

Evidence of dust-bathing in dry, loose soils (KMG), often in shade of shinnery oak mottes (Copelin 1963). No information on other behaviors.

Sleeping, Roosting, Sunbathing

From Copelin 1963, except as noted. Apparently roosts on ground in vegetation with overhead cover <1.0 m and having scattered distribution (Jones 1963a). Roost sites typically found in draws or ridges with good grass cover; moderately grazed pastures used more frequently than overgrazed pastures. Birds roost singly or in groups, but birds in groups roost >1.0 m apart. In fall and winter, roosting sites have taller grass cover than foraging sites (Davis et al. 1979).

Agonistic Behavior

Physical Interactions

Male. During breeding season, males congregate on relatively small arenas. Males defend individual territories on the arena against intruding males (Sharpe 1968, Hjorth 1970, Haukos 1988). Individual territory sizes, likely varying in response to male density on leks and to dominance status, range from 3.5 (Copelin 1963) to >7 m in diameter (Hjorth 1970). Most behavior on leks has developed into ritualized display; specific behavior pattern depends on the particular encounter or situation (Sharpe 1968, Hjorth 1970). Threat behavior during aggressive encounters between territorial males includes elevating tail, spreading and drooping primaries, exposing superciliary eye-combs, and elevating pinnae (Sharpe 1968). Chases are common when males intrude into another male's territory. Arrival of hens often stimulates intense aggressive behavior, including prolonged chases and fights (Hjorth 1970).

Female. Dominance behavior often exhibited when several females simultaneously attend leks (Sharpe 1968). Dominant hens may chase other hens from locations of dominant males and engage in display behavior: erecting pinnae, drooping wings, and raising tail (Sharpe 1968).

Communicative Interactions

Male. Gobbling Displays function to defend territories from neighboring males, to advertise territory location to hens, to give a phenotypic cue of vigor or fitness of indiv-idual males, and to facilitate copulation (Sharpe 1968, Haukos 1988). Males display by exposing and enlarging the superciliary eye-combs, elevating tail to highest extent, erecting pinnae and positioning them forward and parallel to the ground, drooping wings and spreading primaries, extending neck and head in forward position, stamping feet on ground and moving forward, and expanding esophageal air sacs and producing Booming vocalization (see Sounds: vocalizations, above; Grange 1940, Copelin 1963, Sharpe 1968, Hjorth 1970, Johnsgard 1983, Haukos 1988). Flutter Jump, or Wing-Beat, appears to be stimulated by hens flying or walking onto arena; males may rise 2–3 m and often rotate 180° when alighting, sometimes onto shrubs (Sharpe 1968). Usually only a short burst of wing strokes during Flutter Jump; birds keep their bodies fairly horizontal when landing (Hjorth 1970). Sharpe (1968) reported 80% of Flutter Jumps were accompanied by a Cackle. Forward Displays (Hjorth 1970) consists of feet stamping, Gobbling, and tail-flicking and usually peaks before sunrise; given by males from center of their territory and directed at neighbors. During peak display most males on leks will be displaying. Dueting (Antiphonal Booming) usually involves 2 males, although other males may participate. Dueting males usually face each other from up to 5–6 m apart and alternate Yodeling as a dual display. Face-offs

(confrontations) appear to be a territorial display between males and often follow Dueting or Forward Displays and occur at territorial boundaries of adjacent males. During Face-off, both birds lie in semiprone position facing each other with their bills only a few centimeters apart. Face-offs usually involve bowing directed at opposing male. Face-off may lead to fighting, Yodeling, ritualized preening, or resting (Sharpe 1968, Hjorth 1970). Males assuming Appeasement Posture appear to make themselves smaller by withdrawing head, sleeking contour feathers, dropping tail well below horizontal, covering all but tips of primaries with flank-feathers, reducing or covering superciliary eye-combs, and lowering pinnae against neck (Sharpe 1968).

Female. Female Booming (see Sounds: vocalizations, above) observed when several hens are concentrated in small area on lek; frequently followed by rushing at adjacent hens (Sharpe 1968). Dominant hen may be the most receptive to mating and is often followed off lek by closest male (Sharpe 1968, Haukos 1988).

Spacing

Territoriality

Males have high fidelity to leks (Campbell 1972), although yearlings were more likely to switch leks between years than males (Hagen et al. 2005a). Males defend and maintain individual territories on leks during breeding season, although some males defend different locations on a lek in mornings and evenings (Haukos 1988). Marked males used same territorial area within lek for 2 yr (Hjorth 1970, KMG); older males (>1.5 yr of age) are more likely than younger males to occupy central territories (KMG), but proportion of adults or yearlings that hold territories or attend leks is unknown. Yearling males may visit several leks before establishing a territory (Copelin 1963, Hagen et al. 2005a). See Habitat: breeding range, above, for physical description of display grounds.

Territories on leks consist of central area in which other males are rarely encountered and boundary area in which aggressive interactions are common. Reported territory sizes in Kansas ranged from <40 to >150 m^2 (Hjorth 1970); dominant males in center of leks have smaller territories than peripheral males have. Territory boundaries are often oriented with substrate or vegetative features, although in sandy soils substrate is not stable, resulting in frequent changes in territory boundaries (Haukos 1988).

Males reported attending leks Jan–Jun and Sep–Nov (Jones 1964a); exhibit display activity throughout range from mid-Feb through early May (Copelin 1963, Hoffman 1963, Jones 1964a, Donaldson 1969, Crawford and Bolen 1975, Suminski 1977, Davis et al. 1979). Male attendance is highest early in breeding season, remains constant during hen attendance, and declines rapidly thereafter (Crawford and Bolen 1975, Davis et al. 1979, Haukos 1988, KMG). Fall attendance at leks is primarily by males; adults usually assume the same territories they held in spring (Copelin 1963).

Average number of males attending leks varies seasonally and annually, and is influenced by habitat and population density. In sand sagebrush habitats in Colorado, average number of males attending leks was 9.4 (median 8.0, range 1–42, n = 434 leks); 31.3% of leks had 10–20 males, and 7.4% had >20 males (KMG). In shinnery oak rangeland in Texas, average number of males attending leks was 13.7 (range 1–43, n = 244 leks); 37.7% had 10–20 males, and 21.3% had >20 males (Copelin 1963). Average number of males attending leks in other areas ranged from 10 to 21 (Davison 1940, Donaldson 1969, Crawford and Bolen

1975, 1976c, Locke 1992). Average lek size from an intensively studied population in Kansas was 10.2 (median = 11.5 range = 4□23, *n* = 25 leks; CAH). Numbers of attending males may be influenced by habitat adjacent to leks, with more males displaying at sites characterized by native rangeland or reverted cropland than at sites altered by humans (Crawford and Bolen 1976c). Analysis of lek count data from several areas and different habitats suggests that density of displaying males has strong positive correlation with lek density, but not with average number of males per lek (Cannon and Knopf 1981).

Males arrive on leks 30–60 min before sunrise and remain for 3–4 h (Copelin 1963, Sharpe 1968, Crawford and Bolen 1975, KMG). Number of males peaks from sunrise to 105 min after sunrise (Crawford and Bolen 1975, KMG). Evening attendance and display at leks are common in spring (Sharpe 1968, Donaldson 1969, Hjorth 1970, Suminski 1977, Davis et al. 1979, Haukos 1988, KMG); number of males at leks peaks <1 h before sunset (Crawford and Bolen 1975).

Aggressive behavior between hens may disrupt mating on leks, causing delays in matings of subordinate hens or interruptions of copulations (Sharpe 1968, Haukos 1988, KMG).

Individual Distance

Spacing of territorial males on leks ranges from <4.5 (Copelin 1963) to >7 m (Hjorth 1970). In roosting flocks, individual birds >1 m apart (Copelin 1963).

Sexual Behavior

Mating System And Sex Ratio

A polygynous and lek mating system, where males gather on traditional sites to attract females and mate. Relatively few males perform the majority of copulations on a lek (KMG); e.g., 2 males performed >92% of copulations observed on 1 lek in Oklahoma (Sharpe 1968). Males sometimes display to females not on leks (Locke 1992), and some mating may occur off the lek, possibly in response to disturbance (Haukos 1988).

Estimates of male:female sex ratios vary: 1.46:1 for juveniles trapped in Oklahoma (Davison 1940), 0.86–1.13:1 for hunter-harvested juveniles, and 0.87–2.04:1 for hunter-harvested adults in New Mexico (Lee 1950, Snyder 1967, Campbell 1972). Overall reported sex ratio for adults reported above is 1.72:1; however, these data may be biased and may reflect differential vulnerability to trapping or harvest or different habitat preferences in the fall.

Pair Bond

No true pair bond; polygynous mating system on lek, with mating primarily by dominant males (Sharpe 1968). Some females may attend >1 lek during breeding season (Haukos 1988). Intensity of display is greatest when females are present on lek or territory (Donaldson 1969, KMG). Females solicit copulations by squatting and drooping their wings (Copelin 1963, Sharpe 1968, KMG). Males approach females from side or back and copulate when standing on female's back. Successful copulations last only a few seconds and are followed by rapid ruffling of feathers by female, after which she flies away from lek (Sharpe 1968, KMG).

Social And Interspecific Behavior

Degree Of Sociality

Highly social. Males form flocks associated with specific leks in spring (Suminski 1977,

KMG). Females often visit leks in small flocks (Sharpe 1968, Haukos 1988, KMG). Broods sometimes intermingle (Copelin 1963, Pitman 2003). Fall and winter flocks may exceed 80 individuals (Copelin 1963, Ahlborn 1980). Flock size in New Mexico declined throughout winter (Smith 1979).

Nonpredatory Interspecific Interactions

No information.

Predation

Kinds Of Predators

Predators of adults and chicks include Rough-legged Hawk (*Buteo lagopus*), Red-tailed Hawk (*Buteo jamaicensis*), Prairie Falcon (*Falco mexicanus*), Cooper's Hawk (*Accipiter cooperii*), Northern Harrier (*Circus cyaneus*), Ferruginous Hawk (*Buteo regalis*), Golden Eagle (*Aquila chrysaetos*), Great Horned Owl (*Bubo virginianus*), coyote (*Canis latrans*), badger (*Taxidea taxus*), and gopher snake (*Pituophis melanoleucus*; Campbell 1950, Copelin 1963, Davis et al. 1979, Sell 1979, Ahlborn 1980, Merchant 1982, Haukos 1988, Hagen 2003). Predators of nests and eggs include Chihuahuan Raven (*Corvus cryptoleucus*), coyote, badger, striped skunk (*Mephitis mephitis*), ground squirrel (*Spermophilus spilosoma*), and gopher snake (Davis et al. 1979, Haukos 1988, Haukos and Broda 1989, KMG, Pitman 2003).

Response To Predators

Adults respond to terrestrial predators by assuming an alert posture with fully extended neck. Responses to avian predators include squatting motionless, sometimes moving beneath nearby vegetation, and turning head skyward to observe predator. Birds flush singly or in flocks if predator approaches too closely (Campbell 1950, KMG). Use tall cover of either scattered or clumped vegetation as escape cover (Jones 1963b).

Breeding Sounds

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Breeding

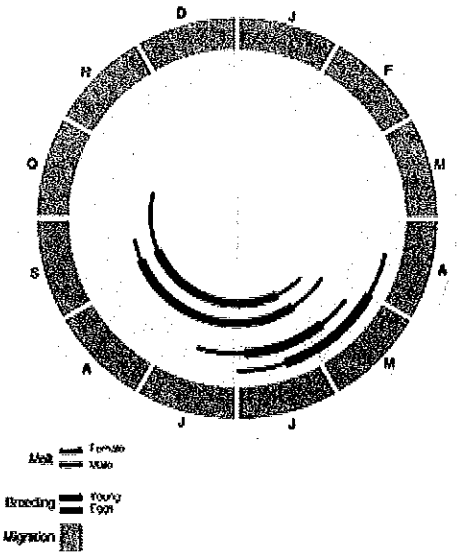

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Fig. 3. Annual cycle of breeding and molt of the Lesser Prairie-Chicken.

Phenology

Pair Formation

Females attend leks from late Mar through May. On average, female attendance on leks (and their copulations) peak during second and third weeks of Apr in Colorado (Hoffman 1963, KMG), New Mexico (Campbell 1972, Suminski 1977, Riley 1978, Candelaria 1979, Davis et al. 1979, Ahlborn 1980), Oklahoma (Davison 1940, Copelin 1963, Jones 1964a, Donaldson 1969), and Texas (Crawford and Bolen 1975, Haukos 1988; Fig. 3). However, female attendance at leks as estimated from captured birds: 81% of captured females had attended at least one lek by 9 Apr from 1998□-2002 in sw. Kansas (CAH). Annual variation as result of extreme weather conditions; drought or late snowstorms may delay peak of female attendance 1□2 wk (Merchant 1982, Haukos 1988, Jamison 2000, KMG). Females

that are observed at leks after early May may be renesting after failure of initial clutch (Pitman 2003, KMG).

First/Only Brood Per Season

Nests are initiated mid-Apr through late May, usually within 2 wk of lek attendance and copulation (Bent 1932, Copelin 1963, Snyder 1967, Merchant 1982, Haukos 1988, KMG). No information on differences among populations. Hatching peaks late May to mid-Jun throughout range (Copelin 1963, Merchant 1982, KMG, Pitman 2003). Second nesting attempts (after first clutch destroyed) initiated mid-May to early Jun, with hatching mid-Jun to early Jul (Merchant 1982, KMG, Pitman 2003, Patten et al. 2005).

Nest Site

Site Characteristics

Shinnery oak or sand sagebrush grasslands with high canopy cover and moderate vertical and horizontal cover, primarily residual vegetation; vegetative height above nest bowl averages 43–81 cm (Donaldson 1969, Suminski 1977, Riley 1978, Davis et al. 1979, Wisdom 1980, Haukos and Smith 1989, Riley et al. 1992, Giesen 1994b). Height and density of forbs and residual grasses greater at nest site than on adjacent rangeland (Davis et al. 1979, Haukos and Smith 1989, Riley et al. 1992, Giesen 1994b, Pitman et al. 2005b). Nest often under sand sagebrush or shinnery oak shrub (Bent 1932, Donaldson 1969, Davis et al. 1979, Sell 1979, Giesen 1994b) or tall bunchgrasses (*Aristida*, *Schizachyrium*, and *Andropogon*; Riley 1978, Wisdom 1980, Haukos and Smith 1989). Litter and bare ground may exceed 70–80% of soil surface adjacent to nest (Suminski 1977, Giesen 1994b). Nests frequently on north- or northeast-facing slopes for protection from prevailing southwest winds and direct sunlight; nests typically in areas with average slope <6% (Davis et al 1979 .)

More recently anthropogenic features such as buildings, paved roads, power lines, agricultural edge and oil wells appear to affect nest site selection and may impact 1 km area of habitat around such features (Pitman et al. 2005b).

Distance Between Nest And Lek

Average distance between leks where females were captured and where they nest is 1.2□3.4 km (range 0.2□13.9, *n* = 90 nests; Suminski 1977, Riley 1978, Candelaria 1979, Davis et al. 1979, Sell 1979, Ahlborn 1980, Giesen 1994b). In Kansas, distances from lek of capture to nest sites (n = 149) varied greatly (range = 0.13□30.3 km), but averaged 2.3 km (median 1.4 km), distances similar to those reported elsewhere (Pitman 2003). Females often nest closer to a lek other than the lek where they mate (Giesen 1994b, Pitman 2003). Average distance from nearest lek was similar for successful and unsuccessful nests; nests closer or farther than average from leks were less successful (Phillips 1990).

Nest

Structure And Composition Matter

Females form bowl-shaped depressions in soil substrate, which they line with dried grasses, leaves, and feathers (Bailey 1928, Bent 1932, Copelin 1963, Donaldson 1969, Suminski 1977, KMG).

Dimensions

Nest bowls average approximately 20 cm wide and 8–10 cm deep (Copelin 1963, Haukos

1988). Average nest diameter 17.7 cm (range = 14 –21 cm, n = 131) in Kansas (J. C. Pitman, Indiana Department of Fish and Wildlife, unpubl. data).

Maintenance Or Reuse Of Nests, Alternate Nests

No evidence that old nests are reused. For renesting attempts and in consecutive years, birds build nests in different locations (Pitman 2003, KMG).

Eggs

Size

Eggs typically ovate, averaging 42.01 (range 40.50–43.93) x 31.60 mm (range 29.17–33.50, *n* = 86; Bent 1932, W. Alther [Denver Museum of Natural History] pers. comm., L. Kiff [Western Foundation of Vertebrate Zoology] pers. comm.). Average eggshell mass 1.69 g (*n* = 11; L. Kiff pers. comm.).

Color

Varies from cream or ivory yellow sprinkled with fine dots of pale brown or olive (Bent 1932, Short 1967) to pale creamy white to gray olive to buff with fine lavender colored markings; two-thirds of eggs may be unspotted (Bendire 1892, Snyder 1967).

Surface Texture

Smooth and glossy (Bent 1932).

Egg-Laying

First egg of clutch is laid 1□2 wk after copulation; if female's first clutch is depredated, she may begin second clutch within 2 wk (KMG). In Kansas, on average second clutches initiated 12.3 d (range = 3□-26 d, n = 17) after first nest was lost (J. C. Pitman, Indiana Department of Fish and Wildlife, unpublished data). Females lay 1 egg/d, occasionally skipping 1 d. During egg-laying, eggs covered with vegetation when female is absent; not so during incubation (KMG). No data on inter- or intraspecific egg-dumping.

Incubation

Onset Of Broodiness And Incubation In Relation To Laying

Incubation by female only. Incubation begins after last egg is laid.

Incubation Patch

On female only (KMG); shed feathers may be used in nest-lining.

Incubation Period

Lasts 24–26 d (Coats 1955, Sutton 1968).

Parental Behavior

Females take incubation recesses, typically <30 min, usually within 2 h of dawn and dusk to feed (KMG), moving 0.25 (Candelaria 1979) to >2.0 km (Sell 1979) to foraging areas. Clutches not covered during incubation recesses (KMG).

Hatching

Shell-Breaking And Emergence

Time from pipping to nest-leaving 1–2 d (Johnsgard 1983, KMG).

Parental Assistance And Disposal Of Eggshells

Eggshells and unhatched eggs are left in nest (Copelin 1963, Davis et al. 1979, KMG).

Young Birds

Condition At Hatching

Chicks are precocial and nidifugous, leaving nests with hen within 24 h of hatching (KMG).

Growth And Development

No information on changes in molt of Juvenal plumage. Daily movements of broods usually <300 m (Candelaria 1979, KMG); brood home ranges 43□118 ha (Candelaria 1979, Sell 1979, Ahlborn 1980). Chicks capable of short flights at 2 wk of age.

Chicks develop rapidly as males and females reach 90% of expected body mass of yearlings within 76 and 80 d post-hatch, respectively (Pitman et al. 2005a). Skeletal measures of foot, wing-chord, and tarsometatarsus length reach 90% of the expected length by approximately 46 d post-hatch (see Appendix 3).

Parental Care

Brooding

Chicks are brooded under breast-feathers or drooped wings of female parent. During first week, chicks are brooded regularly during day and entire evening. Older chicks are brooded less often during day.

Feeding

Chicks able to feed immediately after hatching. Brood females lead chicks to suitable foraging habitats, such as grasslands with high forb component and insect abundance.

Cooperative Breeding

No documentation of cooperative breeding.

Brood Parasitism

In Kansas, Ring-necked Pheasants (*Phasianus colchicus*) and Northern Bobwhite Quail (*Colinus virginianus*) documented "parasitizing" (egg-dumping) in Lesser Prairie-Chicken nests (Hagen et al. 2002b, Pitman 2003). Pheasant parasitism rates < 3% over six nesting seasons in Kansas (Hagen et al. 2000b) and two nests within 150 m each contained 1 quail egg (Pitman 2003). No other reports of egg dumping from other regions.

Fledgling Stage

Juveniles able to fly short distances by 2 wk of age (KMG). Brood breaks up and gains independence from hen at 12–15 wk; coincides with fall dispersal (Pitman 2003).

Immature Stage

After brood breakup, juveniles form mixed flocks with adults (KMG). All juveniles appear to attempt to breed in first year after hatching.

Demography and Populations Behavior

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Demography and Populations

Measures Of Breeding Activity

Age At First Breeding

Although yearling males (0.5–1.5 yr old) attend leks and are physiologically able to breed, older males do most of the breeding. All females apparently breed the year after the year in which they hatch.

Clutch

Commonly 10-12 eggs in complete clutches. Average of 10.4 eggs (range 8-14) in 60 complete clutches reported in 6 studies (Bent 1932, Copelin 1963, Sutton 1968, Merchant 1982, Haukos 1988, KMG). Patten et al. (2005) has documented geographic variation in clutch size between populations in New Mexico (8.7) and Oklahoma (10.8), and attributed this difference to life history strategies adapted to variations in habitat fragmentation and land-use. In captivity, may produce about 25 eggs/female (Coats 1955); hybrid Greater x Lesser Prairie-Chicken produced 26 eggs (Crawford 1978). Clutches of renesting females may have fewer eggs (Pitman 2003, KMG). Clutch size may decrease with later initiation date (Copelin 1963). In Kansas, yearling females had similar clutch sizes (11.8 eggs, n = 61) in first nests as adults (12.3 eggs, n = 81), but slightly larger clutch size in renests (8.3 eggs, n = 11 vs. 7.1 eggs, n = 14; Pitman 2003).

Annual And Lifetime Reproductive Success

Only 1 successful brood/season. If first clutch is depredated or abandoned, some females may lay replacement (renest) clutch (Merchant 1982, KMG, Pitman 2003).

Hatching Success

Averages >90% (Copelin 1963, Merchant 1982, KMG, Pitman 2003). Droughts and hot, dry weather during nesting season may negatively impact hatching success (Merchant 1982).

Nest Success

Percent of clutches that hatch >1 egg averaged 28% (range 0-67%) for 10 studies (Copelin 1963, Donaldson 1969, Riley 1978, Candelaria 1979, Davis et al. 1979, Sell 1979, Ahlborn 1980, Merchant 1982, Haukos 1988, KMG); however, observer disturbance may have increased nest abandonment and nest depredation in these studies. Nest success in native sand sagebrush prairie was lower (26%) than nests in mixed-grass prairie and CRP fields (54%) in Kansas (Fields 2004, Pitman et al. 2005b).

Factors Associated With Nest Success

Successful nests exhibit less variance in distance from nearest active lek than do unsuccessful nests (Phillips 1990). Early nests generally are more successful than later nests (Copelin 1963, KMG, Pitman 2003). Nesting success in drought years less successful than in years of average or above-average precipitation (Merchant 1982). Nest success positively correlated with height, density, and abundance of residual grasses, especially sand bluestem, near nest sites (Riley 1978, Davis et al. 1979, Wisdom 1980, Riley et al. 1992). Nests within or adjacent to tall bunchgrasses or shrubs are more successful than nests in other vegetation (Riley 1978, Wisdom 1980, Riley et al. 1992). Successful nests are characterized by more litter and less bare ground than unsuccessful nests (Davis et al. 1979). Grazing by livestock may reduce nesting success when it results in less residual grass height and density, or less litter and more bare ground (Riley 1978, Davis et al. 1979, Wisdom 1980). Tebuthiuron (*N* -[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]- *N*, *N* 9-dimethyluria) herbicide treatments of shinnery oak, in combination with heavy grazing by livestock, reduces nesting cover and may result in females selecting untreated areas for nesting (Haukos and Smith 1989).

Annual Reproductive Success

In Oklahoma and New Mexico, average brood size (as determined from roadside counts) in late summer (Jul to Aug) ranged from 3.5 to 7.8 chicks; size influenced by annual precipitation patterns, declining in drought years (Schwilling 1955, Copelin 1963, Merchant 1982). Average brood size of radio-marked females was slightly greater in Oklahoma (4.5) than in New Mexico (3.7), and was negatively correlated with survival rates of females (Patten et al. 2005). Average brood size slightly greater in Oklahoma (4.5) than in New Mexico (3.7), and negatively correlated with survival rates of females (Patten et al. 2005).

Reported age ratios from hunter harvest in fall in New Mexico were 53-55% juveniles, with average of 3.7 young/female (n = 923, Lee 1950; n = 2,447, Campbell 1972) and 0.44-3.00 young/adult (n = 37; Merchant 1982). Pitman (2003) estimated survival of chicks from hatch to first breeding at 11% in sw. Kansas; chick mortality occurred mostly within 14 d of hatch, and brood sizes in Kansas were smaller than those reported elsewhere. However, it was suggested that previous estimates of brood size were biased high because they did not account for total brood loss.

Life Span And Survivorship

From Campbell 1972 . Maximum life span in the wild estimated at 5 yr, based on recoveries of banded birds in New Mexico. In New Mexico, percent subadults in spring trap samples suggests average annual adult mortality of 53% for males and females; estimated annual survival rate of banded individuals 35-45% for adult males, 31-32% for subadult males. Live recapture data of banded birds indicated that annual survival was greatest for males between their first and second years (60%) and decreased as birds aged (36-44%; Hagen et

al. 2005a). Annual survivorship of females as determined from radiotelemetry was greater in yearlings (52%) than adults (37%), differences attributed in part to nesting activity (Hagen 2003).

Disease And Body Parasites

Infected with several endoparasites, including nematodes and cestodes (*Oxyspirura petrowi*, *Heterakis isolonche*, *Rhabdometra odiosa*, *Tertrameres* spp., and *Subulara* spp.; Addison and Anderson 1969, Pence and Sell 1979, Robel et al. 2003). Exposed to antibodies of *Mycoplamsa gallisepticum*, *M . synoviae*, *M. meleagridis*, *Pasturella multocida* (avian cholera) and infectious bronchitis (Hagen et al. 2002a, Peterson et al. 2002, Hagen 2003). A hematozoa species *Plasmodium pedioecetti* was found in Texas and New Mexico populations (Stabler 1978, Smith et al. 2003). The protozoan *Eimeria tympanuchi* was detected recently in New Mexico (Smith et al. 2003). However, Lesser Prairie-Chickens have not been exposed reticuloendotheliosis virus (REV), a virus known to be fatal in Greater Prairie-Chickens (Peterson et al. 2002, Wiedenfeld et al. 2002). Emerson (1951) recorded the presence of a louse species (*Lagopoecus* sp.) in Oklahoma. West Nile Virus has not been documented in Lesser Prairie-Chickens.

Causes Of Mortality

Predation on eggs, young, and adults is primary cause of mortality (see Behavior: predation, above). Other causes of mortality include human disturbance, hunter harvest, drought, drowning, and accidents (e.g., flying into power lines or fences, colliding with vehicles; Ligon 1951, Campbell 1972, Sell 1979, Merchant 1982, Hagen 2003, Patten et al. 2005).

Range

Initial Dispersal From Natal Site

Maximum movement between summer brood ranges and display grounds 4.6 km in Oklahoma, with half the population moving <2.3 km; maximum movement from fall-winter site to display grounds 8.0 km (n = 32; Copelin 1963). Fall dispersal of 12.8 km documented for 1 juvenile male in Texas (Taylor and Guthery 1980a). Females tend to disperse farther from natal areas than males (1 km) do (Copelin 1963, Pitman 2003).

Fidelity To Breeding Site And Winter Home Range

Breeding . Limited band return data indicate that adult males have high fidelity to display grounds (Copelin 1963, Campbell 1972, KMG, Bouzat and Johnson 2004, Hagen et al. 2005a). Transplanted birds tend to return to original trap sites (Snyder 1967); 1 female trapped in Kansas and released in Colorado returned nearly 300 km the same year (KMG). Some leks have persisted >30-40 yr in same localities in Oklahoma (Copelin 1963) and Colorado (KMG); average annual turnover of persistent and transient leks in Colorado was 13.8% (KMG). Nesting females may move up to 1.1 km between consecutive-year nests (KMG, Pitman 2003).

Wintering . Observations of marked birds and band recoveries suggest some fidelity to wintering sites in New Mexico, primarily grain fields used for foraging (Campbell 1972, Ahlborn 1980).

Home Range

Spring and summer home ranges in Colorado are smaller for males (211 ha) than for

females (596 ha); males remain closer to leks (KMG). Prenesting home ranges (62–231 ha, *n* = 66) of hens in New Mexico larger than nesting home ranges (8.5–92 ha, *n* = 12), but smaller than postnesting home ranges (73–240 ha, *n* = 38; Candelaria 1979, Merchant 1982, Riley et al. 1994). Females with broods had larger home ranges (119-234 ha, *n* = 10) than females without broods (mean 73 ha, *n* = 27). In Texas, monthly home ranges in winter larger for males (331–1,945 ha, *n* = 4) than for females (35–495 ha, *n* = 4); subadults have larger home ranges than adults (Taylor and Guthery 1980b). Home ranges in Oklahoma and New Mexico increased during drought years because of poor cover and reduced abundance of insect and vegetative food (Copelin 1963, Merchant 1982). Combined home ranges of males and hens associated with leks ranged from 24.5– 51.3 km^2(95% ellipse) to 25.2–61.9 km^2(minimum convex polygon) in Colorado (*n* =4 leks; Giesen 1991). Movements to preferred foraging sites in winter may increase size of fall and winter home ranges.

Population Status

Numbers

Number of males on leks in spring and/or density of display grounds are often used to evaluate population status, and typically show great annual and geographic variation. Spring density estimates ranged from 0.31 to 2.24 males/km^2in Colorado (Hoffman 1963, Giesen 1991), from 0.19 to 11.82 males/km^2in Oklahoma (Davison 1940, Copelin 1963, Cannon 1980), from 1.74 to 1.87 males/km^2in New Mexico (Locke 1992), and from 1.41 to 1.98 males/km^2in Texas (Sell 1979). Line transect estimates of Lesser Prairie-Chicken density in New Mexico ranged from 20 to 26 birds/km^2 in summer to 34–53 birds/km^2 in winter (Olawsky and Smith 1991). Rangewide, average density of leks has ranged from 0.10 to 0.43 lek/km^2(Davison 1940, Sell 1979, Giesen 1991, Locke 1992). Densities of males and leks typically are higher in shinnery oak habitats than in sand sagebrush habitats (Copelin 1963).

Number of active leks positively correlated with density of displaying males (Cannon and Knopf 1981, KMG). Estimates of female numbers are difficult to obtain. Assumptions about sex ratios and male attendance at leks have not been verified; thus relationship between lek counts and total population remains unknown.

Trends

Rangewide, number of Lesser Prairie-Chickens has declined an estimated 97% since 1800s, reflecting 92% reduction in range, including 78% decrease in occupied range since 1963 (Crawford 1980, Taylor and Guthery 1980c; Figure 1). Information on how historical population size was estimated, however, remains unknown. Major droughts in 1930s, 1950s, and early 1990s markedly reduced populations. Increased annual precipitation resulted in small population increases in mid-1980s, but drought conditions in early 1990s caused noticeable rangewide declines in number of active leks and number of males counted.

Population Regulation

Precipitation appears to affect population trends (Brown 1978) with a potential lag effect (Giesen 2000); rain provides more vegetative cover for eggs and chicks, and appears to enhance survival (see nest success, above). The effects of precipitation events are likely exacerbated by land use practices but no studies have clearly demonstrated such cumulative impacts on populations. Nest failure and poor chick survival in general (Copelin

1963, Merchant 1982) may drive population trends more than annual changes in adult survival (Hagen 2003). Such patterns are somewhat predictable for a species with high fecundity and a relatively short life span (Hagen 2003, Patten et al. 2005).

Genetics

Population genetics and potential inbreeding depression has been examined in Colorado, Kansas, Oklahoma and New Mexico (Van Den Bussche et al. 2003, Hagen 2003, Bouzat and Johnson 2004). Van Den Bussche et al. (2003) found reasonable levels of genetic diversity comparing populations in Oklahoma and New Mexico. Regional differences in genetic patterns were evident in these populations using both mitochondrial DNA (mtDNA) and microsatellites, and similar patterns were detected in Colorado and Kansas (Hagen 2003). However, a synthesis of the mtDNA across Colorado, Kansas, Oklahoma, and New Mexico indicated that New Mexico had the lowest genetic diversity (Hagen 2003), likely a result of inbreeding depression (Bouzat and Johnson 2004).

Conservation and Management Breeding

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Effects Of Human Activity

Hunting

Harvest of small populations during population lows may accelerate population declines (Taylor and Guthery 1980c), although no data indicate that hunter harvest was additive mortality. At present (2005), only Kansas and Texas have limited open seasons for Lesser Prairie-Chickens; recent harvest estimates indicate that <500 individuals harvested annually in each of these states. See also Management, below.

Pesticides And Other Contaminants/Toxics

No documentation of direct mortality from pesticide applications. Herbicide treatment of rangeland is detrimental when it results in loss of nesting, loafing, and brood-rearing cover (Copelin 1963, Donaldson 1969, Doerr and Guthery 1980, Rodgers and Sexson 1990, Olawsky and Smith 1991) or causes reduction of invertebrates or mast used as food by adults or juveniles (Jackson and DeArment 1963).

Degradation Of Habitat

Species has declined primarily because of loss and alteration of sand sagebrush and shinnery oak rangelands (Crawford 1980, Taylor and Guthery 1980c). Conversion of 5–37% of rangeland to small-grain cropland in Texas did not have detrimental effects in some areas, because cropland replaced natural foraging habitat (Crawford and Bolen 1976a). Limited reduction in densities of shinnery oak and sand sagebrush after herbicide applications did not reduce populations of Lesser Prairie-Chickens in New Mexico, Texas, and Oklahoma if adequate cover and foods remained (Donaldson 1969, Olawsky and Smith 1991). Lesser Prairie-Chickens in Oklahoma established leks in rangeland burned in spring (Cannon and Knopf 1979).

The impact of anthropogenic features on otherwise available habitat is not limited to nest

site selection (Hagen 2003). The effects of power lines and buildings on habitat use were measurable for at least 1 km buffer (Hagen 2003, Pitman et al. 2005b). Land use patterns and human structures (e.g., fences) may severely impact survivability of females (Patten et al. 2005).

Management

Conservation Status

In Colorado, classified by state as Threatened since 1973. Currently a candidate for listing under Federal Endangered Species Act. The Lesser Prairie-Chicken Interstate Working Group, made up of members representing the U.S. Fish and Wildlife Service and the 5 states that have Lesser Prairie-Chickens, has completed a conservation plan for management of this species (Mote et al. 1999), and guidelines for managing habitat and monitoring populations have been established (Hagen et al. 2004a).

Measures Proposed And Taken; Effectiveness Of Measures

Hunting Legislation . Legislation regulating hunting harvest was enacted in Kansas in 1861 (Horak 1985), and in remaining states having populations of Lesser Prairie-Chickens by early 1900s. Hunting seasons were closed in Colorado in early 1900s, and in other states for various periods in response to population levels. At present (2005), limited hunting allowed in Kansas and Texas.

Predator Control . No predator control projects to enhance populations have been documented.

Provision of Food and Water . Artificial sources of water and food have been provided to wild populations as direct management practice or as result of agricultural or range management practices. Although sometimes used, free water sources or agricultural grains have not been documented to affect populations other than by temporarily influencing their distribution (Copelin 1963, Jones 1964a, Snyder 1967, Crawford and Bolen 1973, 1976b, Crawford 1974, Taylor 1978, Sell 1979).

Habitat Improvement . Historically, habitat management efforts have attempted to increase density and cover of native grasses and forbs for nesting, brood-rearing, and loafing cover by protecting small areas from grazing by livestock (Hamerstrom and Hamerstrom 1961, Hoffman 1963); excessive grazing of rangelands, especially during times of drought, is detrimental to reproduction of Lesser Prairie-Chicken (Merchant 1982). Prescribed burning of rangeland may result in Lesser Prairie-Chickens using these areas as lekking sites (Cannon and Knopf 1979). Prescribed burning of more mesic shinnery oak communities can enhance brood habitat through increasing forbs and invertebrate biomass, but may limit nesting cover for 2 years post burn (Boyd and Bidwell 2001). At larger scales the size and interspersion of burned areas should be carefully considered to limit potential negative effects of burning on nesting cover (Boyd and Bidwell 2001). Species is known to use cropland that was restored to grasses under Conservation Reserve Program (Fields 2004). Specifically, CRP fields that have been enhanced with an interseeding of herbaceous vegetation promotes both increases in invertebrate biomass and vegetation structure important to nesting and brood rearing habitat (Fields 2004).

Population Reintroduction . Species transplanted into Colorado at least 10 times, usually into known historical range or occupied habitats, although at least 2 transplants were to

locations outside of their known historical range. None was successful in establishing or increasing populations (KMG). In Oklahoma, 2 transplants: one in unoccupied range, unsuccessful; the other into range of unknown status, but populations were established (Horton 2000). Species reportedly released on Ni'ihau I., HI (Fisher 1951), but no population is known to exist there now. New Mexico transplanted Lesser Prairie-Chickens into uninhabited ranges in 1930s and 1940s, but efforts were unsuccessful in establishing populations (Snyder 1967). All transplant efforts used wild-trapped birds.

Appearance Demography and Populations

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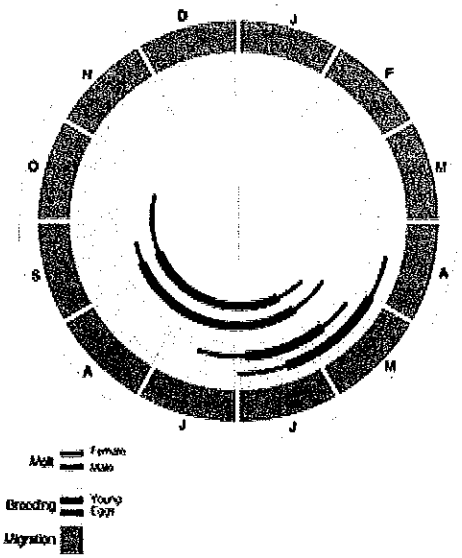
Appearance



Enlarge

Fig. 3. Annual cycle of breeding and molt of the Lesser Prairie-Chicken.

Enlarge

Adult male Lesser Prairie-Chicken, Gobbling Display; Kansas, May

Enlarge

Adult female

Lesser Prairie-Chicken; Colorado, April

Molts And Plumages

Hatchlings

Underparts pale yellow, and crown and hindneck honey yellow, verging toward cinnamon buff, with fairly large black spots medially on both areas; back and wing chamois, washed with sayal brown or cinnamon; rump honey yellow, overlaid with light tawny; upper back has brownish black or olive brown transverse irregular narrow bars; remainder of back mottled or spotted with same colors; wings have large transverse spots; lower back and rump spotted with brownish black; sides of head and underparts deep colonial buff, but slightly darker on jugulum and upper half of sides of head; small irregular black spot above auriculars (Oberholser 1974). Markings on head include tiny dark spot at each side of base of culmen, dark spot in middle of forepart of crown, slightly larger but less definite dark spot toward rear of crown, 3 vague nuchal spots, and 2 small blackish spots behind eye (Sutton 1964). Similar to Greater Prairie-Chicken, but upperparts paler and purer yellow (less brown) and less heavily spotted with buff, and lacks middorsal streak (Sutton 1964, 1968, Oberholser 1974).

Juvenal Plumage

Primaries 1–8 have erupted at time of hatching. No other information on Prejuvenal molt. Juveniles are cryptically colored with same basic colors as in Definitive Basic plumage, except more rufescent, and crown is between tawny and ochraceous tawny (Oberholser 1974).

Basic I Plumage

Prebasic I molt complete, except for primaries 9 and 10 and their coverts, which are not replaced. Juvenal primaries molt in sequence from innermost feather beginning at 18□20 d after hatching, from mid June to early July. Plumage similar to but richer in coloration than Definitive Basic plumage; primaries 9 and 10 and their 2 distal primary-coverts, retained from Juvenal plumage, are more worn and pointed than newer adjacent primaries and primary-coverts (Oberholser 1974), and distal covert has white in distal portion of shaft (Copelin 1963). All primaries slightly shorter than in Definitive Basic plumage (see Measurements).

Definitive Basic Plumage

Definitive Prebasic molt complete; apparently begins after breeding season (late May to June) for males, and after nesting attempt (June or July) for females (CAH). No information on order of feather replacement or on duration of molt.

Male . Forehead and anterior part of crown pale cartridge buff, feathers mummy brown on their concealed basal portions; remainder of crown-feathers dark mummy brown, broadly

edged with cartridge buff to light ochraceous buff and sub-terminally banded with light ochraceous salmon and, still more basally, spotted with the same; head and nape similar, but dark mummy brown areas are reduced to narrow bars, and tips are more strongly ochraceous. Interscapulars, back, lower back, rump, and uppertail-coverts buffy brown to pale olive brown, narrowly banded with pinkish buff to cinnamon buff and with dark clove to fuscous black, the subterminal fuscous black bars banded lengthwise to include a continuous pale olive brown to pale cinnamon buffy band bordered by narrower fuscous black ones; tips of these feathers become somewhat more grayish on lower rump and upper-tail-coverts.

Scapulars, lesser upperwing-coverts, and secondaries tawny olive to olive brown, barred with pinkish buff to whitish, these pale bars edged with fuscous on scapulars and secondaries and with clove brown on upper-coverts; scapulars and secondaries broadly tipped with pale pinkish buff. Median and greater upperwing-coverts and primaries buffy brown, the coverts banded with buffy white, the primaries spotted transversely on their outer webs with pale pinkish buff.

Rectrices clove brown, paling on lateral feathers to dark brown, and all narrowly tipped with pale pinkish buff. Lores, chin, upper throat, and sides of head cartridge buff, tinged especially on sides of head with pale chamois; a dark Saccardo's umber subocular band, the feathers tipped with clove brown; lower cheeks have mass of closely packed dark clove brown spots; feathers of sides of neck and lower throat ochraceous tawny (chiefly on concealed parts of feathers), broadly tipped with white and edged with fuscous black, the ochraceous tawny showing much more on lower throat than on sides of neck; pinnae (a patch of 15 or more elongated feathers on side of neck) composed mostly of black, abruptly truncated feathers, a few of the lateral ones with various widths of buffy white shaft-stripes, these pale areas edged with ochraceous buffy, and these feathers considerably ochraceous tawny basally, their upper-coverts largely ochraceous tawny and buffy white.

Breast, upper abdomen, sides, and flanks whitish, each feather crossed by several fairly narrow bars of buffy brown to olive brown, these bars becoming broader and darker on sides and flanks, where they are bicolored□paler in middle and darker on margins; on middle and lower abdomen, the dark bars are greatly reduced in breadth and darkness or are lacking entirely. Legs fully feathered to base of foot; brownish proximally, becoming paler distally. Undertail-coverts (some of which extend to tip of tail) clove brown, very broadly tipped with ochraceous tawny on their inner webs; underwing-coverts whitish, outer ones terminally spotted with drab to pale buffy brown (Ridgway and Friedmann 1946). Eighteen rectrices; 16 uppertail-coverts (Short 1967).

Female . Females have cross-bars on crown and tail feathers. Similar to male, except rectrices have pale spots (Copelin 1963, Campbell 1972, KMG). The cross-bars on retrices are diagnostic in determining gender of chicks at approximately 34 d post-hatch (Pitman et al. 2005a). Pinnae also shorter in females (Sell 1979, Haukos 1988, KMG).

Bare Parts

Bill And Gape

Adult bill is dark brown (Oberholser 1974), with lighter tip. Bill of newly hatched chicks is a warm, bright, yellowish orange, except for base of mandible, which is pinkish flesh color (Sutton 1968). Bill color becomes darker with age (Sutton 1968).

Iris
Dark hazel brown in young chicks (Sutton 1968), dark brown in adults (Oberholser 1974).

Bare Skin On Head And Neck
Cervical apteria (air sacs) on side of male's neck become large and round when inflated during courtship displays. Color described as reddish (Bailey and Niedrach 1965, Crawford 1978, Johnsgard 1983), dull red (Oberholser 1974), rosy (Copelin 1963), or cinnamon buff, reddish brown, or tan (Sutton 1977) when inflated during breeding displays. Males also have bright yellow or slightly ochraceous orange yellow eye-comb above each eye, which is enlarged during courtship displays (Sutton 1977, Johnsgard 1983).

Legs And Feet
Toes of young chicks bright yellowish orange (Sutton 1968). Feet of adults dark yellow, claws brownish black (Ridgway and Friedmann 1946, Oberholser 1974).

Measurements Conservation and Management
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Measurements

Linear

Total length, and lengths of wing-chord, pinnae, and tail, greater in males than in females, and within each sex tend to be greater in adults than in yearlings, although some skeletal measurements may differ (tarsus length) among age or sex classes (see Appendix 1). Differences among areas and studies may reflect differences in how measurements were recorded. Length of primaries (inferior umbilicus to tip) greater in males than in females, and within each sex, greater in adults than in yearlings (see Appendix 2).

Mass

Body mass of males greater than that of females; adults weigh more than yearlings (see Table 1). Body mass varies throughout year; males heaviest in late winter before breeding, females in late spring before egg-laying (KMG). On average, males may lose 5% of their body mass from breeding season to autumn (Hagen et al. 2004b). Mean body fat (measured as % wet body mass) from May to Jul: 2.8% ± 1.0 SD for males (n = 37) and 3.1% ± 1.7 SD for females (n = 15) in West Texas and e. New Mexico (Olawsky 1987).

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Priorities for Future Research

Because methods of inventory for this species rely primarily on counts of males on display grounds, documentation of the percentage of males that obtain territories on leks and of spring sex ratios are critical for estimating population size and ascertaining trends. Populations are becoming increasingly fragmented and isolated, so information is needed on dispersal, population and metapopulation dynamics, minimum population size, and minimum habitat patch size to ensure viability. Translocation or other methods for restoring extirpated populations need to be evaluated. Empirical research on the effects of land management practices□including grazing systems, brush control methods, and other range management and restoration practices□on the nutritional and energetic needs, productivity, survival, and seasonal habitat preferences of the Lesser Prairie-Chicken is critical for managing habitats and maintaining viable populations of this species.

Acknowledgments Measurements

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Data Tables and Appendices

Table 1.
Body mass (g) of Lesser Prairie-Chicken by age, sex, and region. Data shown as mean (n).

Appendix 1.
Appendix 1. Linear measurements (mm) of yearling and adult male (YM, AM) and female (YF, AF) Lesser Prairie-Chicken. Data shown as mean (n).

Appendix 2.
Primary lengths (mm) of Lesser Prairie-Chicken from Colorado (KMG). Data shown as mean ± SD (range, n).

Appendix 3.
Measurements (mean ± SE) of body mass, foot length, tarsometatarsus (tarsus) length, and wing length recorded from juvenile Lesser Prairie-Chickens 0-60 days post-hatch in sw. Kansas, 2000-2002. Time intervals of 5 or 6 days were used to summarize the data depending upon sample size (After Pitman et al. 2005a).

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	Male (g)		Female (g)	
	Yearling	Adult	Yearling	Adult
Colorado				
KMG (Baca County)	724 (30)	762 (46)	712 (46)	730 (28)
CAH (Prowers County)	737 (3)	764 (9)		
New Mexico				
Candelaria 1979		734 (9)		679 (31)
Merchant 1982		684 (19)		
Patten et al. 2005*				726 (27)
Texas				
Haukos 1988	806 (105)	813 (66)	728 (44)	772 (11)
Olawsky 1987		743 (37)		628 (18)
Sell 1979	748 (10)	750 (11)	707 (9)	740 (10)
Kansas (Hagen et al. 2004b)				
Finney County	790 (210)	807 (294)	710 (95)	749 (108)
Comanche County	729 (5)	752 (9)		
Kearny County	785 (3)	797 (26)		
Oklahoma				
Patten et al. 2005*				721 (37)

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Table 1.

Body mass (g) of Lesser Prairie-Chicken by age, sex, and region. Data shown as mean (n).

- * Patten et al. (2005) did not distinguish between age-classes.

Close

THE BIRDS OF NORTH AMERICA

Region and source	Measurement (mm) Wing-chord YM	AM	YF	AF	Tarsus YM	AM	YF	AF	Foot YM	AM	YF	AF
Colorado												
KMG (Baca County)	219.0 (28)	219.9 (44)	211.3 (44)	213.3 (22)								
CAH (Prowers County)	208.0 (3)	208.9 (9)			54.3 (3)	53.6 (9)			49.0 (3)	47.5 (9)		
Texas												
Sell 1979					97.3 (11)	96.4 (12)	96.2 (9)	97.8 (9)				
Kansas (Hagen et al. 2004)												
Finney County	205.4 (10)	209.6 (19)	201.3 (3)	202.9 (10)	54.1 (10)	54.3 (15)	52.7 (3)	51.8 (10)	47.7 (10)	49.5 (20)	49.0 (3)	47.4 (10)
Comanche County	209.4 (5)	208.8 (9)			54.2 (5)	53.3 (9)			48.4 (5)	48.3 (9)		

Lesser Prairie-Chicken

Tympanuchus pallidicinctus | ***Order*** *GALLIFORMES* – ***Family*** *PHASIANIDAE*

ppendix 1.

Appendix 1. Linear measurements (mm) of yearling and adult male (YM, AM) and female (YF, AF) Lesser Prairie-Chicken. Data shown as mean (n).

Linear measurements (mm) of yearling and adult male (YM, AM) and female (YF, AF) Lesser Prairie-Chicken. Data shown as mean (n).

Close

THE BIRDS OF NORTH AMERICA

	Morphometric measurement							
Age (d) *	*n*	Mass (g)	*n*	Foot (mm)	*n*	Tarsus (mm)	*n*	Wing (mm)
0-5	14	17.3 ± 0.8	19	20.5 ± 0.3	19	19.2 ± 0.6	5	20.4 ± 0.5
6-10	8	26.0 ± 0.4	12	24.4 ± 0.3	12	23.4 ± 1.1	4	57.8 ± 3.1
11-15	10	39.4 ± 0.7	10	24.9 ± 0.1	10	26.1 ± 0.2	0	--
25-30	4	123.0 ± 13.1	3	38.7 ± 1.3	3	40.0 ± 1.5	2	125.0 ± 6.0
31-35	15	187.4 ± 14.7	7	42.4 ± 1.2	7	45.3 ± 0.5	1	147.0
36-40	11	236.2 ± 10.8	7	44.3 ± 0.4	7	46.5 ± 1.0	5	154.0 ± 1.4
41-45	2	238.5 ± 21.5	2	44.5 ± 0.5	2	49.0 ± 2.0	1	162.0
55-60	9	406.8 ± 7.8	9	44.9 ± 0.4	9	51.6 ± 0.6	8	180.9 ± 1.6

Lesser Prairie-Chicken
Tympanuchus pallidicinctus* | *Order* *GALLIFORMES* – *Family* *PHASIANIDAE

Appendix 3.

Measurements (mean ± SE) of body mass, foot length, tarsometatarsus (tarsus) length, and wing length recorded from juvenile Lesser Prairie-Chickens 0-60 days post-hatch in sw. Kansas, 2000-2002. Time intervals of 5 or 6 days were used to summarize the data depending upon sample size (After Pitman et al. 2005a).

- * No data were collected from chicks between 16-24 and 46-54 days post-hatch.

Close

Lesser Prairie-Chicken
Tympanuchus pallidicinctus
Order
GALLIFORMES
– Family
PHASIANIDAE
Issue No. 364
Authors: Giesen, Kenneth M.
Revisors: Hagen, Christian A.

- Articles
- Multimedia
- References

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